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Being Scientific: Saryu Fensin

Lab Character: Who We Are



Saryu Fensin

**Sparkling innovations in both
materials science and shock
physics**

As an enterprising materials scientist, Saryu Fensin leverages both experiments and simulations to improve understanding of how materials behave when subjected to extreme forces.

Her aim is to use the complementary techniques to design and develop innovative materials for use in extreme conditions such as stockpile-focused applications.

“To certify our stockpile with confidence, we need to understand the role a material’s microstructure plays in determining its dynamic properties,” Saryu says. “I’m hoping to solve this puzzle and improve our predictive capability to model material response in extreme conditions. Achieving this kind of specific controlled functionality of materials could have a big impact on the Laboratory’s national security science mission.”

Her tools include molecular dynamics, Monte Carlo methods, gas gun experiments, metallography and various microscopy techniques. She looks forward to the prospect of new capabilities that could let her "see" inside materials.

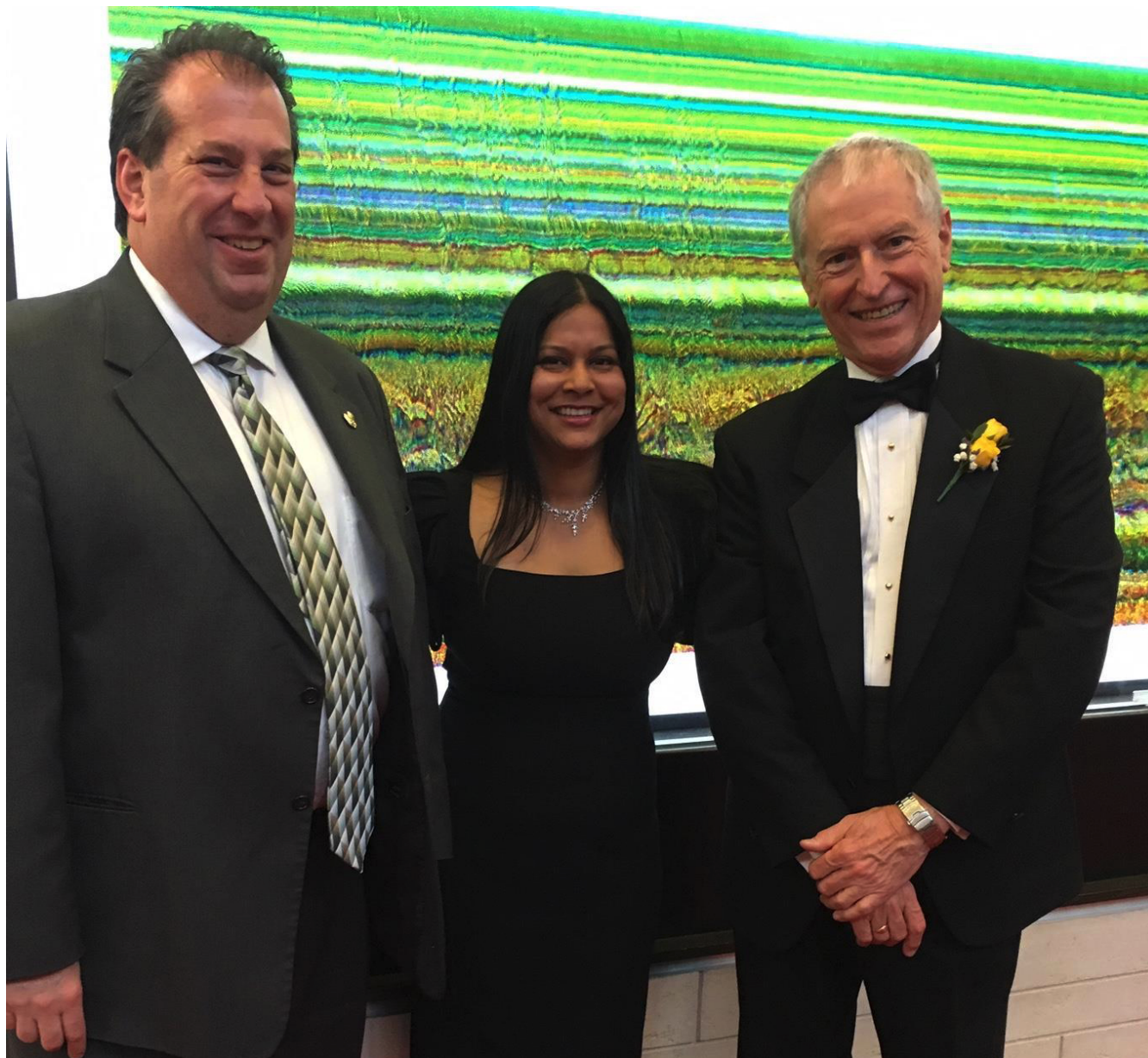
Winning streak started early

Saryu (Materials Science in Radiation and Dynamics Extremes, MST-8), who earned her doctorate in materials engineering from the University of California, Davis, first made an impact on the field of dynamic materials research after becoming a Los Alamos postdoctoral researcher in 2010.

Recent research had shown that not all grain boundaries in materials were equally susceptible to damage and failure. The common belief was that boundaries with low energy did not fail. Saryu used molecular dynamics simulations of copper to show grain boundary energy wasn’t the phenomenon preventing failure. The way boundaries dissipate stress dictated their susceptibility to failing.

The project’s success enhanced communication between experimentalists and modelers in the group, says **Steve Valone**, an MST-8 guest scientist and Saryu’s former mentor. Combining the two approaches helped the researchers to better predict failure and develop damage-tolerant materials.

"I like being able to perform cutting-edge experiments that aren’t possible to pursue elsewhere in the world," Saryu says. "I enjoy working in an application-based field. Everyone needs materials!"



With Dan Thoma, her former deputy division leader, and mentor Rusty Gray (right). Saryu has won two "young leader" awards from The Minerals, Metals & Materials Society.

Blending chemistry, materials science, simulation, experiment

Saryu takes pride in using multiple approaches: her experiments inform computational models that, in turn, inform experiments, in a process called codesign.

In a recent study published in the journal *Nature Communications*, Saryu and collaborators used

Argonne National Lab's Advanced Photon Source synchrotron-radiation light source to measure strain in a loaded copper film. They modeled the atomic structure and showed that the measured strain field corresponded to a specific kind of dislocation in the lattice structure. This experiment could help determine how defects cluster and contribute to strain in a material.

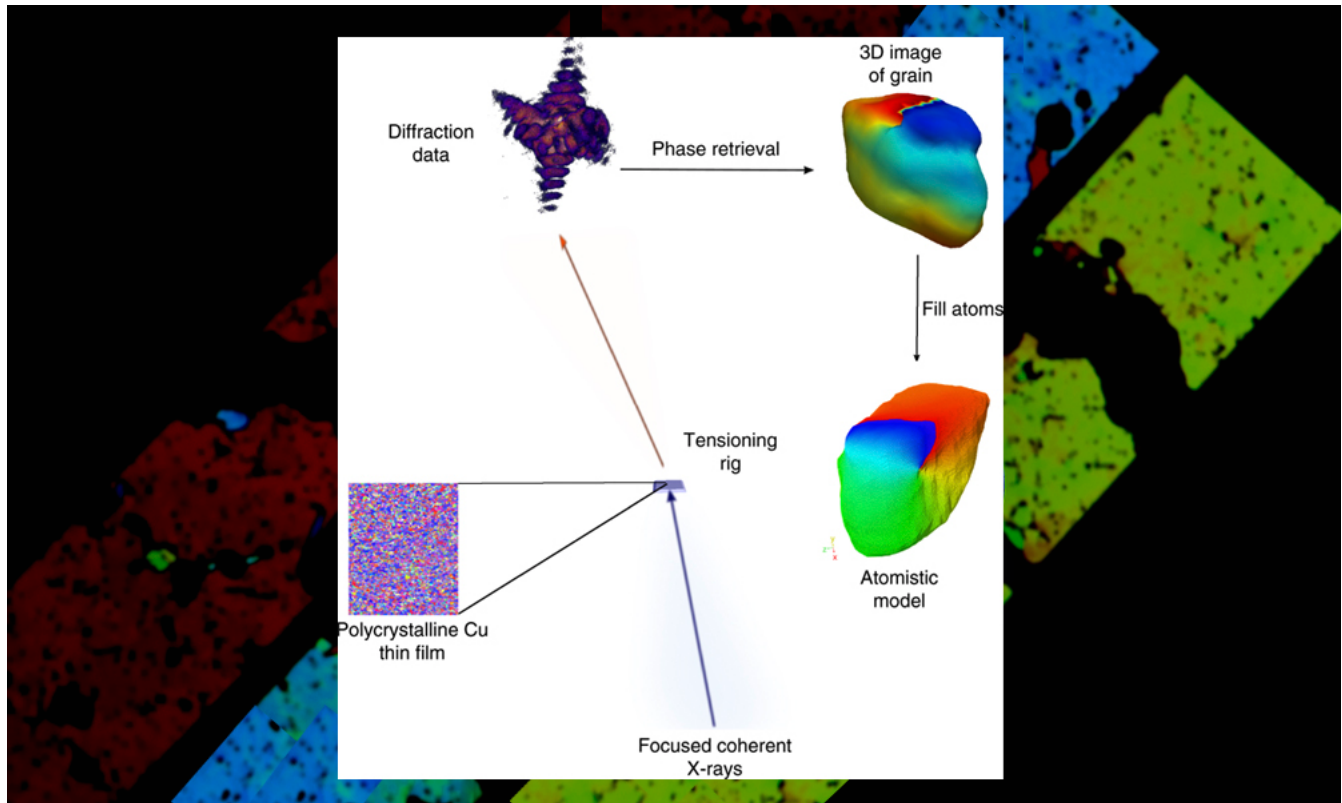


Figure from Nature Communications paper: Coherent x-ray diffraction imaging in Bragg geometry. Focused coherent x-ray pulses are incident on the polycrystalline copper sample.

Saryu also contributes to a joint experimental and modeling study of the instabilities that affect materials' strength and ejecta. The project, sponsored by the Primary Assessment Technologies science campaign, will also simulate molecular dynamics to explain the mechanisms that drive differences in materials' behavior.

"My unique background has helped me ask questions about dynamic behavior of materials that sometimes end up being new and exciting," said Saryu, whose undergraduate degree is in chemistry. The complex, systematic experiments she and her teammates perform are leading to "innovations in both materials science and shock physics, which is really exciting," she says.

Next-gen capabilities would probe unexplored realms

With the Lab's proposed Dynamic Mesoscale Material Science Capability (a project formerly known as MaRIE, Matter-Radiation Interactions in Extremes), Saryu could directly validate both her simulations and experiments to further certify the stockpile.

"Seeing inside materials as they are subjected to an external stimulus is the holy grail for material science. Advanced light sources let us perform cutting-edge experiments and shed light on undiscovered phenomena," Saryu says. "If I had an even more advanced hard x-ray capability such as MaRIE, I'd love to discover in real time where voids nucleate in metals and to measure their growth rates. I also want to understand the basic mechanisms that contribute and dictate the overall mechanical response of metals."

This experimental facility would fulfill a capability gap identified by the U.S. Department of Energy's National Nuclear Security Administration. The concept includes an electron accelerator that creates coherent x-rays with experimental areas to probe materials at the spatial scale beyond the atomic, molecular and nanoscale, where a material's structure strongly influences its macroscopic behaviors and properties.

Dedicated scientist and mentor

Saryu, who is a leader on The Minerals, Metals & Materials Society's (TMS) scientific committees, sets an inspiring example for those she mentors.

After receiving a 2015 Young Leaders International Scholar-Japanese Institute of Metals (JIM) Award, she represented TMS at the Tokyo University of Science in Japan. And she previously won a TMS Young Leaders Professional Development Award in the Electronic, Magnetic and Photonic Materials Division.

"Saryu's ability to explain concepts and to direct research truly sets her apart from other mentors I have had," said **Rachel Flanagan** (MST-8), a PhD candidate at the University of California, San Diego.

"What really impresses me about Saryu is her dedication to her work, her resourcefulness and her ability to connect with other researchers. She sets an amazing example for the type of scientist I hope to become."



Editor's Note: This story was adapted from an article in MST e-News, a newsletter published by the Materials Science & Technology Division.

Know someone who embodies a Lab character trait and deserves some recognition? Send nominations to dianadel@lanl.gov.



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